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ABSTRACT

In 1965 a parliamentary commission began a review of the whole system of competency and university admission in Sweden in order to simplify it and bring it into line with other education reforms. The research projects undertaken as a basis for making reform recommendations were published in 1970, and the findings are briefly reviewed here. The studies cover both research in other countries and Swedish research on predictors of success: tests and grades. (MSE)

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# RESEARCH IN SWEDEN WITH REGARD TO PREDICTIVE TESTS AND INTERVIEWS FOR ADMISSION TO HIGHER EDUCATION

by

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## BACKGROUND

Admission to universities and most other institutes of higher education in Sweden has by tradition been open. The entrance requirement has been a Diploma from the upper secondary school (gymnasium) including a mark level of "Pass" in those subjects required for the particular field of study at the university.

Originally this Diploma was offered as an entrance ticket to the universities in Sweden after oral and written examinations given by the universities. From 1864 these examinations were taken over by the upper secondary schools under a certain control from the universities. The marks from the upper secondary school have therefore by tradition been accepted by the universities as a basis for entrance requirements.

Because of lack of resources or after policy decisions, entrance to certain sectors of higher education became more restricted. This has been the case, particularly after the Second World War, when the whole school system in Sweden expanded rapidly. Since the examinations system and the marking practices in the upper secondary schools were under central control and fairly equal over the country, it was natural for the universities to use the marks for selection, when this was necessary. This has been the case for many years in schools of Medicine, Dentistry, Technology and Social Work, to mention some. The marks were used in different ways. Some admission offices used the sum of marks or the mean marks, while others gave extra weight to marks in some more relevant subjets. The schools of Technology, for example, gave extra weight to marks in Physics,

Chemistry and Mathematics. The students were allowed to raise their marks or add marks from new subjects by taking extra examinations after the gymnasium examination.

Particularly after 1945 the use of objective tests, interviews and other measures, became popular. This was partly an effect of the growing influence of British and American psychology with its emphasis on measurement. Partly it was a result of the rapidly growing number of applicants and the need for differentiating among students with the same mark level.

In this connection test construction and several research projects were started. The predictive validity of tests and other instruments was studied. Results from these studies were used for changes in the procedures. There was for example a tendency to reject marks taken on extra examinations to raise the mean marks. Research indicated that adding these marks decreased the predictive validity of the mean mark from the gymnasium examination. They also tended to favour students coming from higher socio-economic strata.

Changes of the selection instruments were made fairly often and in an unsystematic fashion. The system of admission then became more complicated and the applicants had difficulties to understand it. Parallell with this the whole Swedish educational system was under heavy expansion and drastic change. Both the school system and the universities were reformed through political decisions. All this made it neccessary to rewiev the whole system of entrance requirements, admission methods etc.

A NEW SYSTEM OF ADMISSION

In 1965 a Parliamentary Commission started to review the whole system of competency and admission in order to make it simpler and more in line with the other reforms of the educational system. It had certain instructions, for example, the following:

1. To stress real competence instead of formal.
2. To give access to university studies for new groups, eg, adult students with other educational background than the upper secondary school.
3. To avoid bias against any category like a particular sex or socio-economic class.
4. To make the system simpler.

The Commission started a number of research projects to get a better basis for its recommendations. The following are of particular interest:

1. Reviews of research on methods for prediction of academic success done in Sweden and other countries.
2. New projects on the predictive value of tests and marks.
3. Studies of the effects of giving varying weights to marks in different subjects.
4. Construction of a test battery for prediction of academic sucess.

Results of this research programme was published in two volumes, namely Marklund, S., Henrysson, S. and Paulin, R. Studieprognos och studieframgång (Study prediction and Study success) SOU 1968:25, Stockholm 1968 and Behörighet. Meritvärdering. Studieprognos (Competency. Merit rating. Study prediction) SOU 1970:20 Stockholm 1970. These volumes give a good picture of Swedish research on prediction of academic success before 1970.

THE COMMISSION'S REVIEW OF RESEARCH IN OTHER COUNTRIES

This review (Henrysson 1968) discusses the problem of a criterion of success in research on predictive validity. Mean mark, rank in class, or similar summary ratings given by the school teachers are the usual criteria. Research on other criteria is needed.

The following main kinds of predictors have been studied :

1. Marks or other ratings of study results,
2. Achievement tests,
3. Aptitude tests,
4. Personality tests or ratings,
5. Interest data,
6. Biographical information.

Particularly the three last kinds of data are sometimes collected and pooled together by use of an interview.

The main result of this review is that the three first kinds of predictors tend to have the highest correlations with mean marks or similar criteria. Which one is best depends on the criterion, the type of students, restriction of range, different errors and limitations in the research design etc. The correlations often are of the size around .50. There is a tendency that the mean mark is a somewhat better predictor than the tests.

The best predictors among the achievement tests seem to be tests measuring rather general outcomes of education like reading skills and general information on a higher cognitive level. Verbal tests are usually better predictors than non verbal test. This has to do with the high verbal impact on the criterion.

If the achievement tests are rather broad and oriented towards general study skills, they tend to correlate fairly highly with verbal aptitude tests. The distinction between many tests of aptitude or intelligence on the one hand and general achievement test on the other hand is often very arbitrary.

The predictive validity of the best combination of marks, aptitude and achievement tests have often been studied by multiple correlation techniques. This line of research indicates that mostly the predictive validity of the best one of these predictors can be improved by adding one or two of the others to the best one. But the improvement is usually not very large.

Measures of personality, interest, etc have mostly low value. This is the case especially in a selection situation when the applicants are trying hard to get high scores or when the question is if the predictive validity of marks, aptitude and achievement tests can be raised by new measures. Background data like socio-economic status can sometimes improve prediction, but can mostly not be used for ethical or political reasons.

THE COMMISSION'S REVIEW OF SWEDISH PREDICTION RESEARCH

The first part of this review made by Paulin (1968 a) contains 60 prediction studies from the period 1955 to 1967 with marks as predictors. Both marks in separate subjects, unweighted mean marks and a weighted mean marks have been used as predictors.

The next part of the review reports 23 studies from the same period with aptitude tests alone or in combination with marks as predictors (Paulin, 1968 b).

A third part of the review (Paulin 1968 c) reports 27 studies where the predictive value is studied of background factors like socio-economic status, age or sex.

The criterion problem is very difficult, since the marks at the university level are not very differentiated or comparable. Usually only Fail, Pass and Pass with honours are used. The mostly unwritten rules for marking vary from subject to subject and from Department to Department. It is therefore very misleading to add data from different subjects and Departments together. The samples are therefore usually fairly small. Sometimes the number of subjects taken per year, the time for reaching a degree, drop out or similar measures are used as criteria. They are of course not very accurate.

Another difficult problem is restriction of range. Very often the predictors under validation are used for selection at the same time. This means that the validation study is restricted

only to those students who were accepted. This and other restrictions of range will result in lower validity coefficients.

It is very difficult to generalize from the results, because of variations between conditions in the different research studies. The variations between validity coefficients are very large. However, there are some general tendencies.

Marks from the upper secondary school on the average has a correlation of +.26 with mean marks at the university, time for reaching a degree or other measures. The range is from -.41 to +.67.

Aptitude tests also happens to have the same average validity coefficient +.26 as grades. The range is from -.13 to +.82. Test batteries tend to have higher predictive validity than single tests.

In the appendix there are some tables from one of the Commission Reports (SOU 1968:25), which give more details.

There is no clear pattern of what specific marks or tests have the highest predictive validity. This is an effect of the variations in design, sample and quality of the different studies.

There are also a few studies of the effect of an interview in combination with tests. They seem to indicate that interviews used for data collection and for integrating data can to some extend improve the predictive validity of tests and marks only.

The results of the research on different background factors are not very clear. These factors interact in a complicated manner. For example, age and practical experience tend to have negative predictive validity. This might be because older and more experienced people tend to have had a less formal education and are less used to taking examinations.

Validation studies with later job success as a criterion are few in Sweden and the validity coefficients have been very low.

THE SPECIFIC RESEARCH PROGRAMME OF THE COMMISSION

To get a better basis for its recommendations, the Commission also started their own research projects. The results have been published (SOU 1970:25) and will be reviewed here.

Prediction of success in studies of Architecture, Mathematics and Political Science

This study was done by Rolf Paulin (1970). He tried to find large groups of male university students with as comparable and valid criteria of success as possible. He then studied the predictive validity of the marks from the upper secondary school and the aptitude tests taken by nearly all males before entering military service in Sweden. The main groups were 96 students of architecture, 187 mathematics students and 362 political science students. The mean mark was the best predictor the verbal aptitude tests were next, while the tests of spatial ability and technical understanding had no or very little validity. The tests add very little to the predictive validity of the mean marks in the multiple correlation analyses.

Prediction of success at the University of Umeå

This project by Henrysson, Elgqvist-Saltzman and Stage (1970) studied to see if the validity of the mean marks could be improved by adding a general ability test. Follow-up studies were made of some large groups of students studying at the same speed and taking the same examinations. Special efforts were made to collect all examinations during one study year and add them together into a fairly reliable and valid criterion. At the end three fairly large groups with complete data were available, i.e. students of Statistics, Education and English.

Table 1. Validity coefficients from the Umeå study.

| Subject | N | Validity coeff. Mean Mark | Abil.Test | Correlation Mean Mark/Ab.test | Multiple correlation |
|---|---|---|---|---|---|
| Statistics | 85 | .21 | .28 | .04 | .35 |
| Education | 99 | .32 | .04 | .20 | .32 |
| English | 149 | .29 | .28 | .10 | .42 |

Table 1 shows that the validity coefficients of the mean marks tend to be a little higher than for the ability test. The validity can in two cases be improved by adding the two predictors. But in spite ot the efforts to get good criterion data the correlations are fairly low on the whole.

Correlations between weighted and unweighted sums of marks

In some admission programmes extra weight has been given to some subjects. For example, the Technical Universities gave extra weight to marks in Physics, Chemistry and Mathematics.

It can be shown that if the correlations between marks are positive and fairly large - and they usually are - the correlations beteewn weighted and unweighted sums of marks tend to be very high. Marklund and Rudemo (1970) showed this by data from 200 students graduating from the Science line of the upper secondary school. An unweighted sum and a sum with double weights to physics, chemistry and mathematics correlated .966. If the weights for these three subjects were 3, the correlation was .945. The weight 4 gave the correlation .924. This indicates that the effect of variations in weights is small in a purely statistical sense. Another matter is that the weights might change the study tactics of the students.

THE PRESENT SYSTEM OF ADMISSION

One of main aims of the Parliamentary Commission and the political decisions made afterwards was to give access to higher education for new categories. The following four groups now fulfil the general requirements for access to university:

1. Those who have passed through the three years' upper secondary school.
2. Those who have passed through the two years' upper secondary school.
3. Those who have passed through the two years' adult education school (Folk High school).
4. Those who are 25 years old, have four years' work experience and know English.

They also have to fulfil special requirements for the subjects they are going to study.

When selection is necessary, each of these four groups are treated separately according to a proportional quota system. This means that the percentage of admitted students from one group is the same as the percentage of applicants coming from this group. For example if 25% of the applicants are from group 1, 25% of the students selected should also come from this group

Selection in group 1 and 2 is based upon the mean marks. In group 3 is used a summary rating of study skill made by the teachers on a 4-point scale. Selection in group 4, the 25 year old adults, is based upon a scholastic aptitude test, which will be discussed below. Work experience is given weight in all four groups. The effects of this system are not yet known.

There are a few exceptions from this general system, for example use of weighted marks, some tests and interviews. The general rule is that it must be shown by research that these other methods have reasonable validity, if they should be used in the future.

THE GYMNASIUM STUDY

A research project from a lower level of the educational system should be mentioned. It was done in connection with admission to the gymnasium in Sweden, i.e. the three years upper secondary school leading to university. The students are admitted to the gymnasium from the 9 years comprehensive school, usually at the age of 16. Mean marks from the comprehensive school are now used as admission instruments. The research pro-

blem was to see if tests could be used as substitutes for or complements to the mean marks. This study was done under leadership by Henrysson and the results are reported in detail by Nordlund (1972). The main reason for reporting this study here is that conditions for prediction research were better on this level than at the entrance to the university for the following reasons:

1. Large groups of students taking the same course of study at the same speed are available.
2. The range of ability is fairly large.
3. The mean marks from the gymnasium are rather valid and reliable criteria. Marks are fairly equivalent between teachers since standardized tests are used for adjustment of standard.
4. The standardized achievement tests from the gymnasium can also be used as criteria.

All 3800 pupils in grade 9 of the comprehensive school in a fairly typical county in Sweden were tested by an ability test measuring verbal and non-verbal ability. They were also given achievement tests in Social Studies (SS), Swedish and English (SE) and Physics, Chemistry and Mathematics (PCM). These achievement tests aimed at fairly general knowledge and applications, since achievement tests of this kind usually are more valid predictors of academic success than fairly narrow tests of detailed knowledge.

The mean marks used as criterion were taken from the end of grade 2 in the gymnasium, since this was expected to give the most valid criteria on large and comparable groups.

The main results are given in table 2. Column 2 reports the validity coefficients for the total material treated as one sample. Column 3 reports the pooled coefficients for the 6 gymnasium schools involved. Columns 4 and 5 gives data for boys and girls separately.

Table 2. Correlations between criterion (mean mark) and predictors in the gymnasium study.

| (1) Predictor | (2) Total N=851 | (3) Mean of schools | (4) Boys N=443 | (5) Girls N=408 |
|---|---|---|---|---|
| Verbal ability | .33 | .33 | .37 | .29 |
| Non-verbal ability | .20 | .20 | .23 | .22 |
| Total ability (V+NV) | .33 | .33 | .38 | .37 |
| Mean marks | .64 | .65 | .67 | .62 |
| Soc. studies | .37 | .38 | .42 | .45 |
| Swed.-Engl. | .45 | .43 | .44 | .44 |
| Phys.-Chem.-Maths. | .35 | .36 | .43 | .44 |

Column 2 clearly indicates that the mean mark is the best predictor with a correlation of .64. (After correction for restriction of range it is .74). The ability test has the validity coefficient .33 and the Swedish-English test - the best predictor of the achievement tests - has the correlation .45. The multiple correlation combining all ability and achievement tests is .48, indicating that the tests are not as valid as the mean marks.

The results in column 3 show that the marks are fairly comparable between schools, since the values are nearly the same as in column 2.

The tests and the mean marks were combined by multiple correlation technique. This gave the multiple correlation .67, showing that tests can improve prediction only a little if marks from the gymnasium are used as criteria.

THE NEW SCHOLASTIC APTITUDE TESTS

As mentioned above, admission in the group of 25 year old adults is based upon scholastic aptitude tests and work experience. The Department of Education at Umeå University is responsible for the test construction (Högskoleprovet, 1976). The test battery is expected to measure scholastic aptitude regardless of university branch and tries to cover three main

areas. They are general ability, study skills and general information. These three aspects are more or less involved in all sub-tests. Predictive validity is not the only consideration. Also the following things have to be kept in mind:

A. Effects on the studies before and after taking the test.
B. Quick and objective scoring.
C. Effects of coaching on the tests.
D. Face validity for the testees and others involved.
E. Possible bias against any sex, scoio-economic group etc.

The present test battery contains the following sub-tests:

1. Vocabulary,
2. Data sufficiency,
3. Reading comprehension,
4. Graphs, tables and maps,
5. Study techniques,
6. General information.

Test number 5, Study techniques, is based upon a small book with different kinds of reading sections, figures and tables. Lists of contents, tables, names and words are included. The task is to find different kinds of information using the tables of contents etc.

The predictive validity of a preliminary test battery has been studied on Teacher Candidates (N=305) and Students of Technology (N=209).

The criteria from the university studies are not very comparable or differentiating, while the validity coefficients, which vary between .4 and .5, can be considered as fairly high under the circumstances.

SUMMARY

Mean marks are the traditional instrument for admission in Sweden. Research indicates that this is the best single predictor of academic success as measured by marks or similar criteria. This is partly because the marks are made comparable between schools by common rules for distributing the marks and by use of standardized tests for equalizing marks given by different teachers.

Ability and achievement tests usually show predictive validity, but in most cases not as high as mean marks. Tests and other instruments add very little to the predictive validity of marks in most cases.

Research on measures of personality, interest etc is limited and shows fairly negative results. Interviews have been used in some admission situations. They can sometimes add to the predictive value of marks and tests.

Rules for admission were changed in connection with a reform of the Swedish system of higher education in 1976. This was based upon research on admission methods. One result of the reform is that work experience is given credit for all applicants. A scholastic aptitude test is now included for adult students who are at least 25 years old.

# APPENDIX

Some results from the review of Swedish prediction research published by the 1965 Parliamentary Commission on Competency and admission.

*Table 2.* Survey of correlations between school marks and later success in studies according to type of criterion.

| Type of criterion | Number of correlations | Mean value of correlations | Lowest and highest correlations | |
|---|---|---|---|---|
| Mean marks | 91 | +.26 | —.31 | +.67 |
| Distinction | 7 | +.42 | +.27 | +.55 |
| Time to examination | 14 | +.17 | —.09 | +.47 |
| Number of courses passed | 34 | +.24 | —.41 | +.58 |
| Number of examinations to degree | 10 | +.24 | +.01 | +.60 |
| Assessment of aptitude for studies | 2 | +.23 | +.20 | +.26 |
| Frequency of degree | 16 | +.22 | —.14 | +.66 |
| Total | 174 | +.26 | —.41 | +.67 |

*Table 3.* Survey of correlations between test results and success in studies according to type of criterion.

| Type of criterion | Number of correlations | Mean value of correlations | Lowest and highest correlations | |
|---|---|---|---|---|
| Mean marks | 120 | +.26 | —.13 | +.69 |
| Number of courses passed | 39 | +.30 | —.04 | +.82 |
| Number of examinations to degree* | 14 | +.12 | +.07 | +.25 |
| Assessment of aptitude for studies* | 7 | +.25 | +.02 | +.35 |
| Total | 180 | +.26 | —.13 | +.82 |

* All correlations are derived from a study.

*Table 4.* Survey of correlations between school marks and success in studies according to predictors.

| Type of predictor | Number of correlations | Mean value of correlations | Lowest and highest correlations | |
|---|---|---|---|---|
| Mean marks | 97 | +.27 | —.31 | +.67 |
| weighted mean marks | 16 | +.33 | +.03 | +.62 |
| unweighted mean marks | 81 | +.25 | —.31 | +.67 |
| Written subjects | 55 | +.26 | —.24 | +.60 |
| foreign languages | 14 | +.30 | +.13 | +.55 |
| Swedish composition | 12 | +.13 | —.24 | +.40 |
| mathematics and physics | 29 | +.29 | —.09 | +.60 |
| Non-written subjects | 14 | +.19 | —.41 | +.45 |
| Practical subjects | 5 | +.06 | —.09 | +.15 |
| Line in »gymnasium» | 3 | +.13 | +.01 | +.24 |
| Total | 174 | +.26 | —.41 | +.67 |

*Table 5.* Survey of correlations between test results and later success in studies according to type of predictor.

| Type of predictor | Number of correlations | Mean value of correlations | Lowest and highest correlation | |
|---|---|---|---|---|
| Test batteries | 37 | +.34 | +.04 | +.82 |
| Individual tests | 114 | +.24 | —.13 | +.65 |
| technical comprehension | 14 | +.24 | +.09 | +.47 |
| spatial aptitude | 10 | +.25 | —.04 | +.49 |
| logical-inductive aptitude | 21 | +.25 | +.03 | +.60 |
| verbal aptitude | 17 | +.11 | —.13 | +.38 |
| other tests reported | 52 | +.26 | —.04 | +.65 |
| Assessment of learning aptitude | 6 | +.39 | +.19 | +.62 |
| Other assessments reported | 23 | +.26 | —.06 | +.52 |
| Total | 180 | +.26 | —.13 | +.82 |

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